Soil, Sediment, and Surface Water Sampling at Small Arms Ranges to Inform the Design of Best Management Practices

Presenters: Larry Jordan (ARCADIS/Malcolm Pirnie)
Jennifer Wilber (Headquarters Marine Corps)

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ARCADIS MALCOLM PIRNIE

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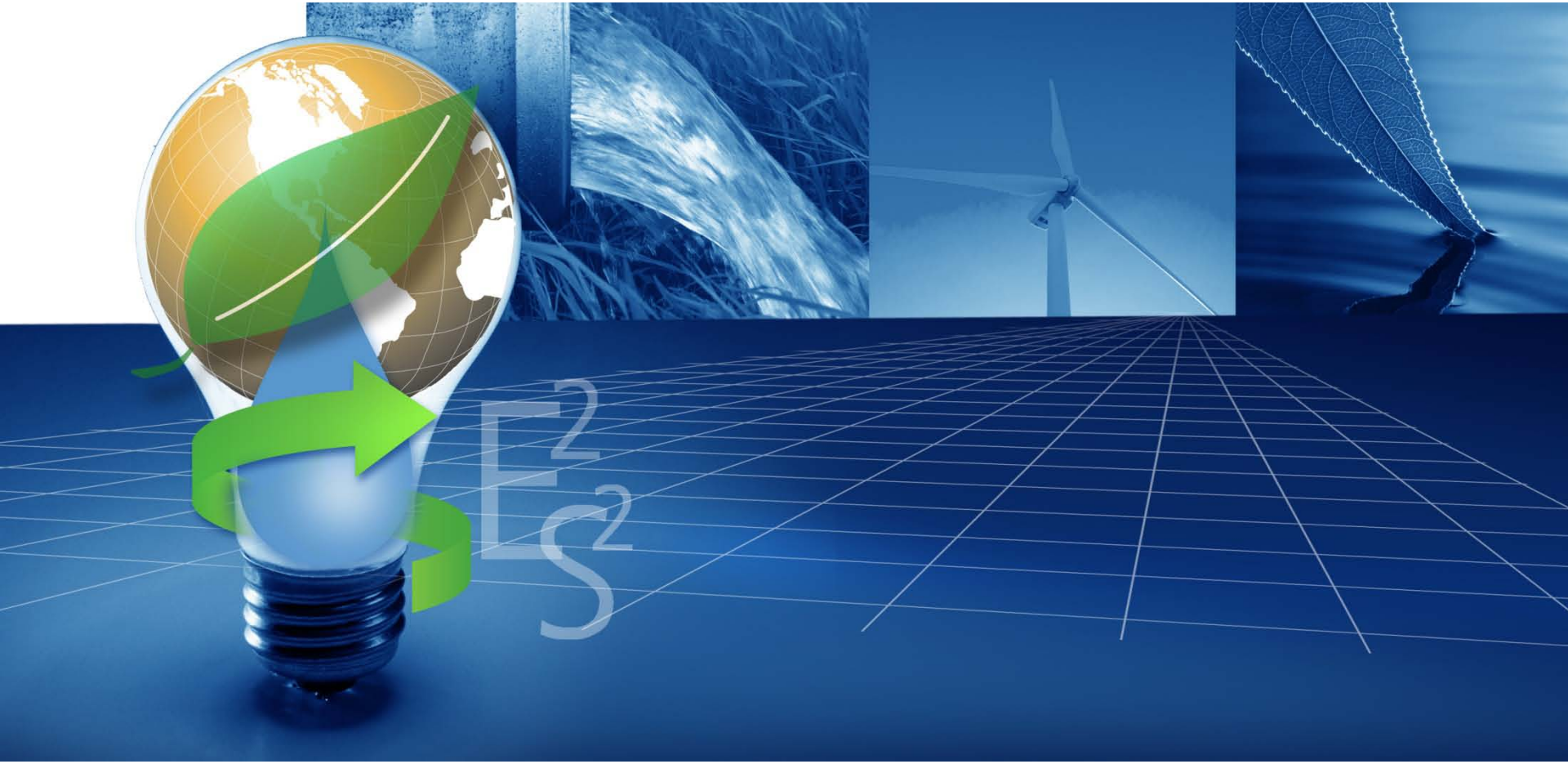
Presentation Overview

- Headquarters Marine Corps (HQMC) has been proactively assessing small arms ranges (SARs) as part of the Range Environmental Vulnerability Assessments (REVA)

- Where we've been
  - Previous activities completed at SARs as part of HQMC REVA program
- What we did
  - Description of activities completed as part of this SAR sampling program and preliminary findings
- Where we're going
  - Description of on-going activities associated with Best Management Practices at SARs



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Definition and Range Prioritization

- SARs - .50 cal ammunition and smaller
  - Ranges where metals are the primary constituents of concern
- Range Prioritization
  - All SARs in the Marine Corps inventory were qualitatively scored using the SAR Assessment Protocol (SARAP)
  - Primarily focused on factors affecting lead (Pb) mobility
    - Most abundant constituent in small arms
    - Mobility is highly dependant on site-specific factors
  - Provided a defensible way to evaluate and prioritize 131 SARs without having to sample everyone
  - Identified ranges that posed the greatest risk for Munitions Constituent (MC) release
  - Allowed for development of range recommendations focused on areas most in need of actions to track or remedy MC releases
  - Prioritization was conducted within each installation and across the entire inventory
  - Solely focused on environmental conditions

Small Arms Range Assessment

- SARs were assessed using SARAP Evaluation Forms
- Conceptual Site Model (CSM) was developed to qualitatively assess the ranges
- Lead – MC indicator for SARs

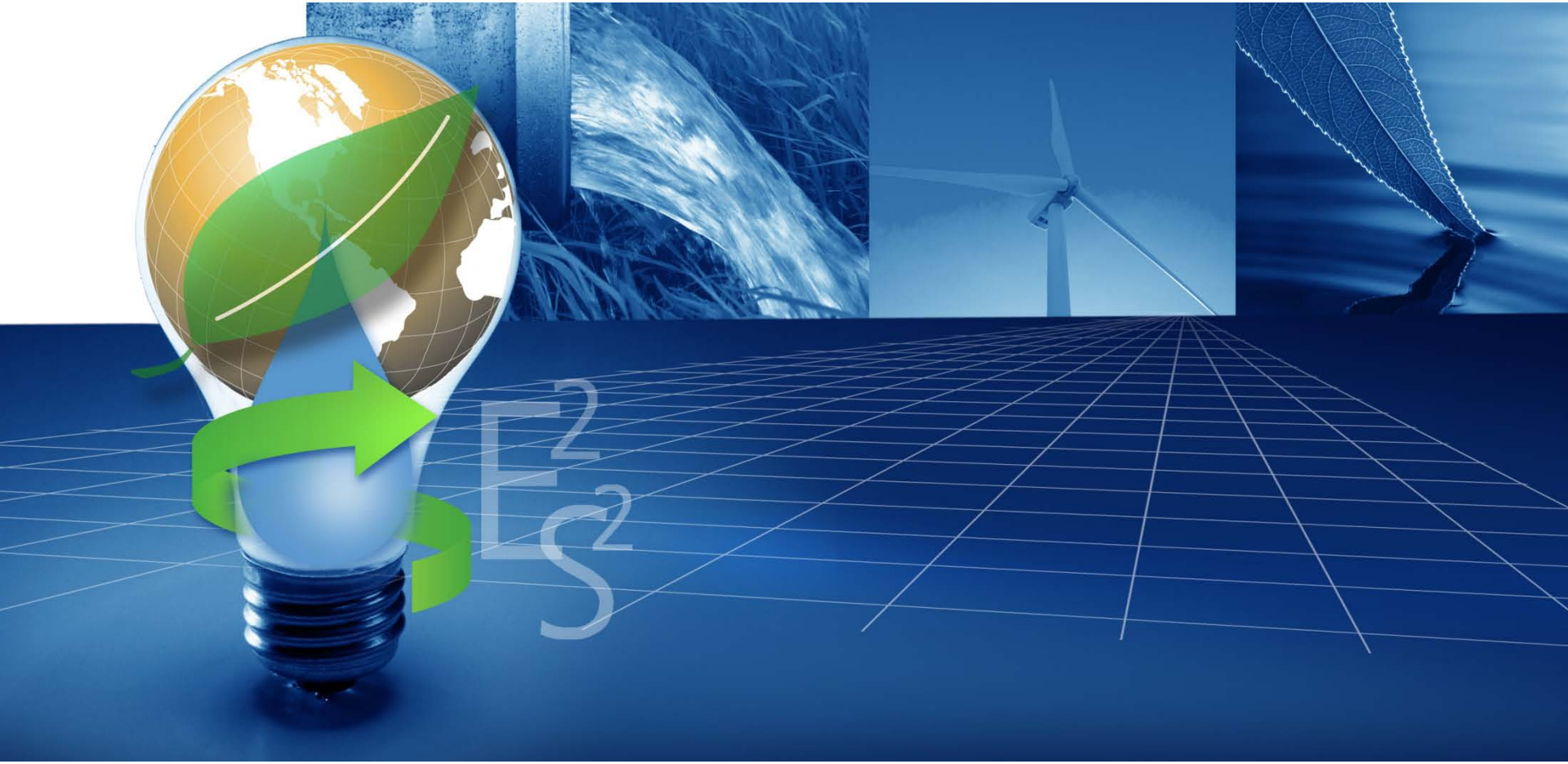
Small Arms Range Protocol Evaluation Forms

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	Length of time the range has been used	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	
Bullet-Capturing Technology	The presence and duration of bullet-capturing technologies Compare the duration of the range use to the duration of bullet-capturing technologies.	If [range usage duration = bullet capture duration], then apply a **negative** score so that the [range usage duration + bullet capture duration] = 1 If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a **negative** score so that the [range use duration + bullet capture duration] = 3 0 if [range usage duration – bullet capture duration] > 30 years	
MC Loading Rates	The amount and types of small arms ammunition expended on the range Estimate the MC loading by using a time weighted average of MC loading rates	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	
Range Maintenance	Frequency of any range maintenance activities involving the removal of lead from the ranges	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	
Source Element Score			
Notes:			

Qualitative Assessment and Prioritization Results

- Fifteen SARs (11% of total) were ranked as HIGH based on the results of the SARAP
  - Sampling was immediately completed to evaluate risk
  - Sampling of appropriate media as part of the REVA program showed that no releases have occurred
- 44% of ranges were ranked as MEDIUM
  - Four were selected for additional sampling (discussed below)
  - Targeted sampling effort to fill data gaps to better understand lead migration
- Low ranked ranges (45% of total) were considered to have no potential for adversely impacting off-range receptors



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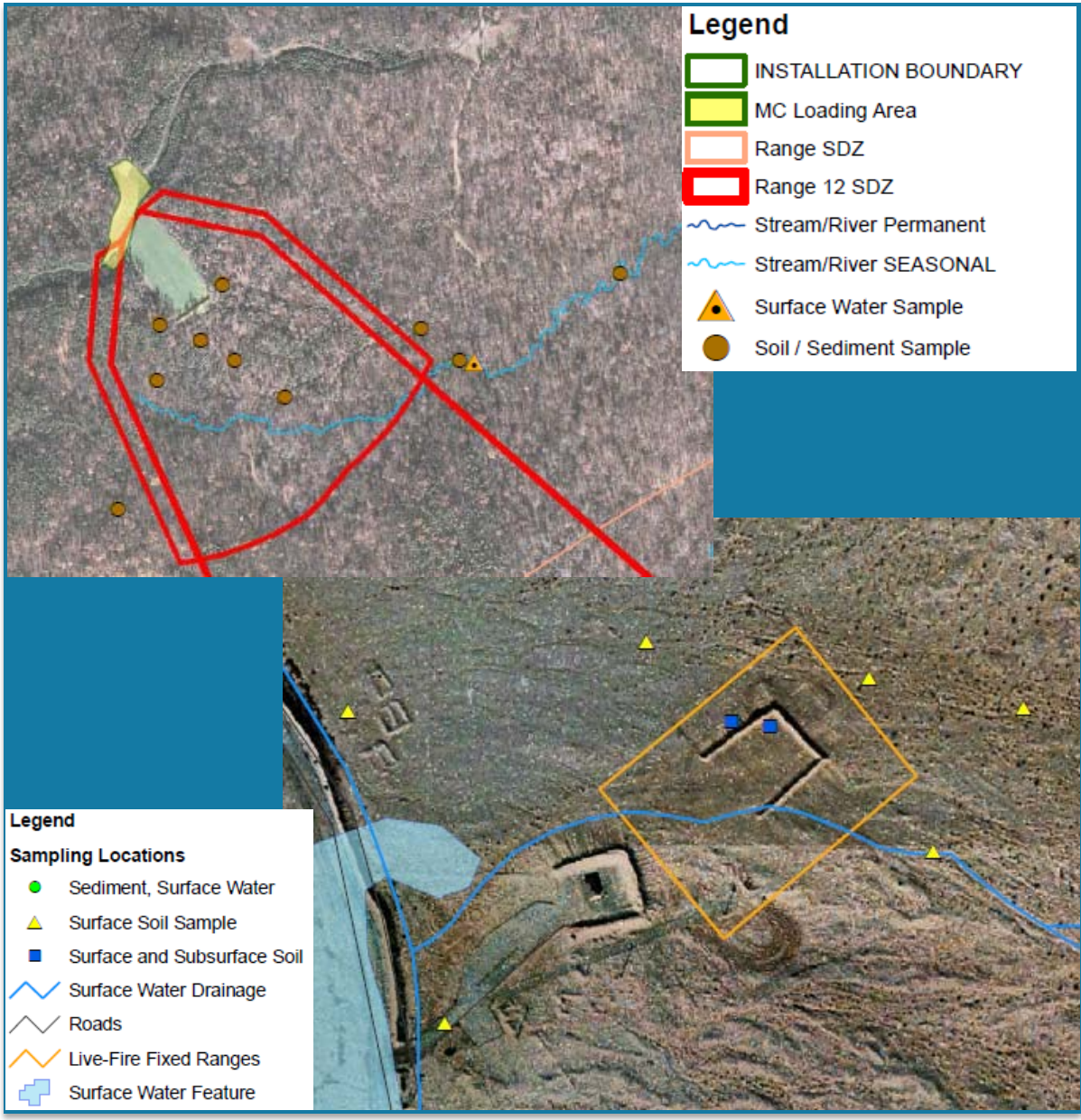
Small Arms Sampling Design

- HQMC requested that a sampling program be completed at four SARs within the Marine Corps inventory
- SARs chosen were all very heavily utilized and represented a cross-section of range types and physical environments
  - Ranges were distributed throughout the United States
    - Covered both arid and rainy environments, various temperature regimes and soil types
  - Range types included various traditional SARs and a Helicopter Gunnery Range
  - Sample location distribution would help show where lead is deposited and where it goes
    - Where should BMPs be placed for greatest effect?

Sampling Plans Included

- Collecting surface and subsurface soil samples from various portions of each of the ranges
  - Samples analyzed for MC and soil parameters which affect MC transport
- Collecting surface water and sediment samples from drainages
  - Samples analyzed for MC and parameters which affect MC transport

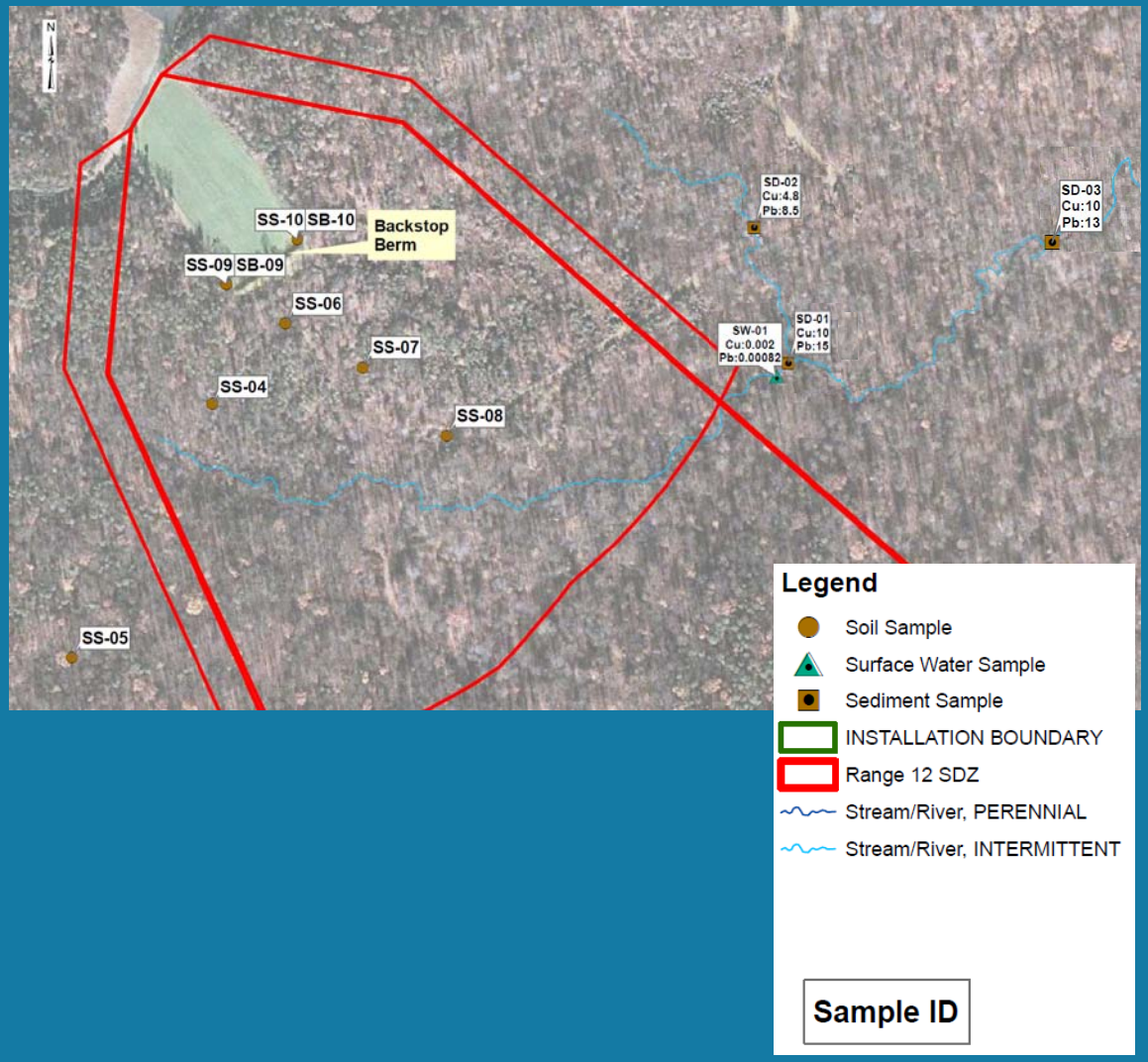


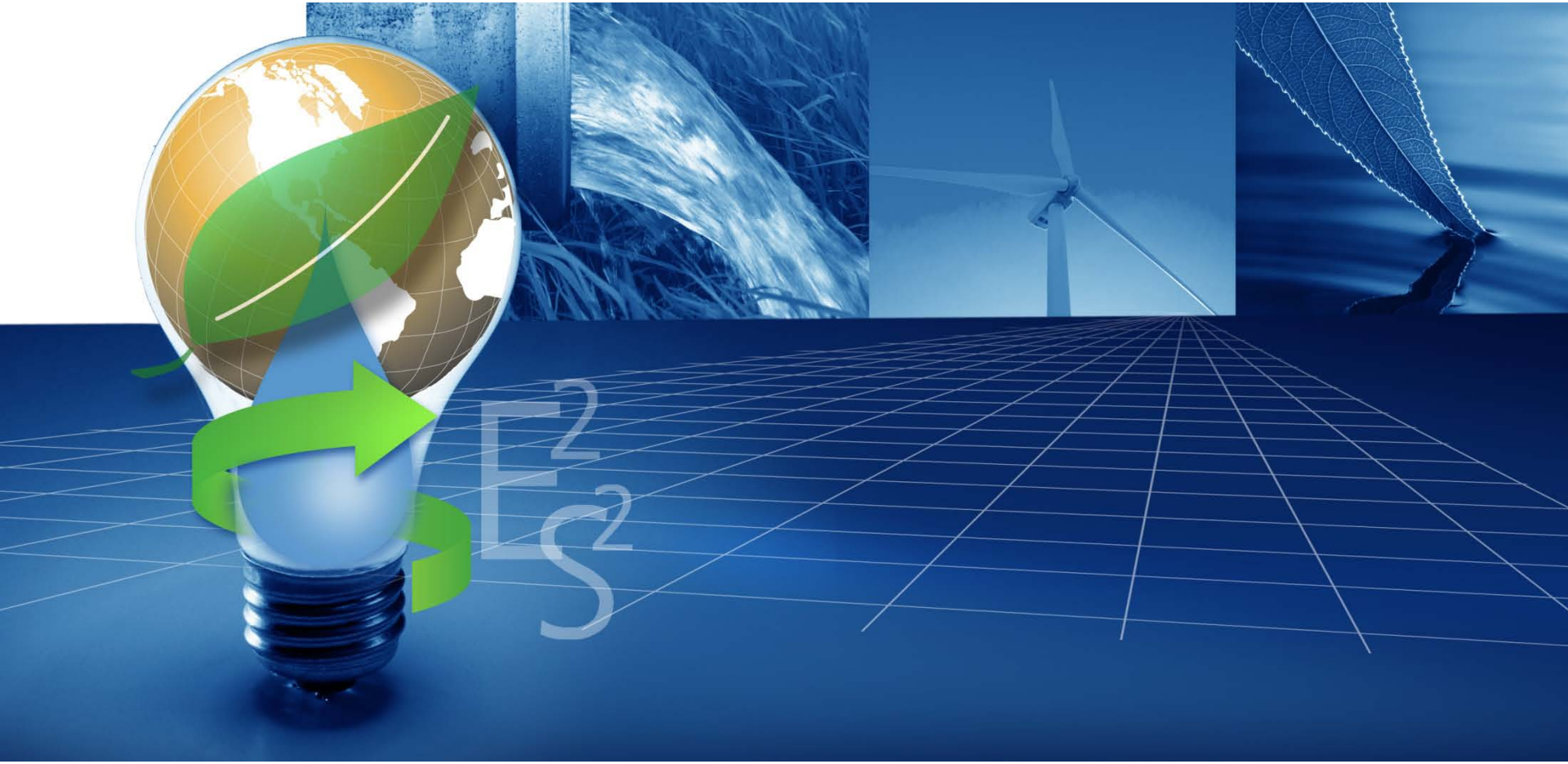
Small Arms Sampling Results

- MC is distributed in soils as expected
  - Highest concentrations are found immediately adjacent to target areas / berms
  - The range floors, back of berms, and areas downrange show concentrations above background
  - MC concentrations in subsurface soils show MC transport during infiltration
    - Concentrations fall off quickly during infiltration and when fine-grained soils were encountered
    - Additional work being completed to evaluate potential migration to groundwater at specific sites
- MC distribution in surface water / sediment heavily influenced by climatic factors and physical range characteristics
  - “First Flush” samples show highest MC concentrations
    - Subsequent storms showed order of magnitude drops in MC concentrations
  - Streams / drainages without a direct connection to potential source areas generally showed no impacts from MC

Small Arms Sampling Results Continued

- Example of drainage without a direct connection to a significant source area
  - MC concentrations in sediment (SD) and surface water (SW) are well below applicable criteria





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Next Steps

- Additional work will be completed at select ranges to understand MC migration in the subsurface
  - Additional activities will evaluate the groundwater pathway at ranges where vertical transport was considered a possibility
- BMP studies at a selection of ranges are ongoing
  - Data collected as part of this evaluation will be used to focus future BMP and range management efforts and will guide additional actions where required
- Five year reviews are underway
  - SARs will be re-evaluated for changes in loading, BMPs, etc.

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